Space Weather Technical Forecast

Issued on Monday, 24 October 2022 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Geomagnetic Storms on 24 and 25 October.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity over the past 24 hours has been Low, with three C-class flares from evolving region AR3130 (Cro/Beta) in the southeast quadrant. AR3126 (Dsi/Beta) in the southwest has also developed a central spot. Two further regions are weak and are considered to present a negligible risk. A CME was observed leaving the southwest quadrant during 23 October and will be analysed once further imagery becomes available.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has steadily increased from 400km/s to a peak of around 550km/s through the period as the Earth entered the influence of coronal hole 34. Density started around average but has steadily increased to above average values, reaching a peak of 18ppcc at 23/1750UTC. Total magnetic field strength has been persistently moderate, with a peak of 13nT at 23/1657UTC before a step change to average around 9nT from this time. The north-south component has been generally weakly positive, with isolated moderate levels, but a sharp negative peak of -8nT was observed at 23/1812UTC. Phi angle was resolutely negative (towards the Sun). Geomagnetic activity was Unsettled between 23/0000-1500UTC and has been Active 23/1500-2400UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2MeV) at GOES-16 was at normal background levels. The associated 24-hour integrated fluence was well below the Active (1e8 integrated pfu) threshold, with 1.26e6 integrated pfu observed at 23/2400UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be mainly Low or Very Low, with an increasing risk of M-class flares later in the period.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs have been observed, although one potential CME will be analysed once further imagery becomes available. The high speed stream from coronal hole 34 is expected to continue at around 500-600km/s through 24 October and perhaps 25 October, perhaps peaking at 650-700km/s. A decline in speeds is then forecast from later on 25 October through the remainder of the period. Geomagnetic activity is expected to be mainly Unsettled to Active on 24 October, with a chance of G1/Minor Storms. There is further risk of G1/Minor Storms on 25 October, resulting in a rapidly decreasing risk from later on 25 October, with activity becoming mainly Quiet to Unsettled.

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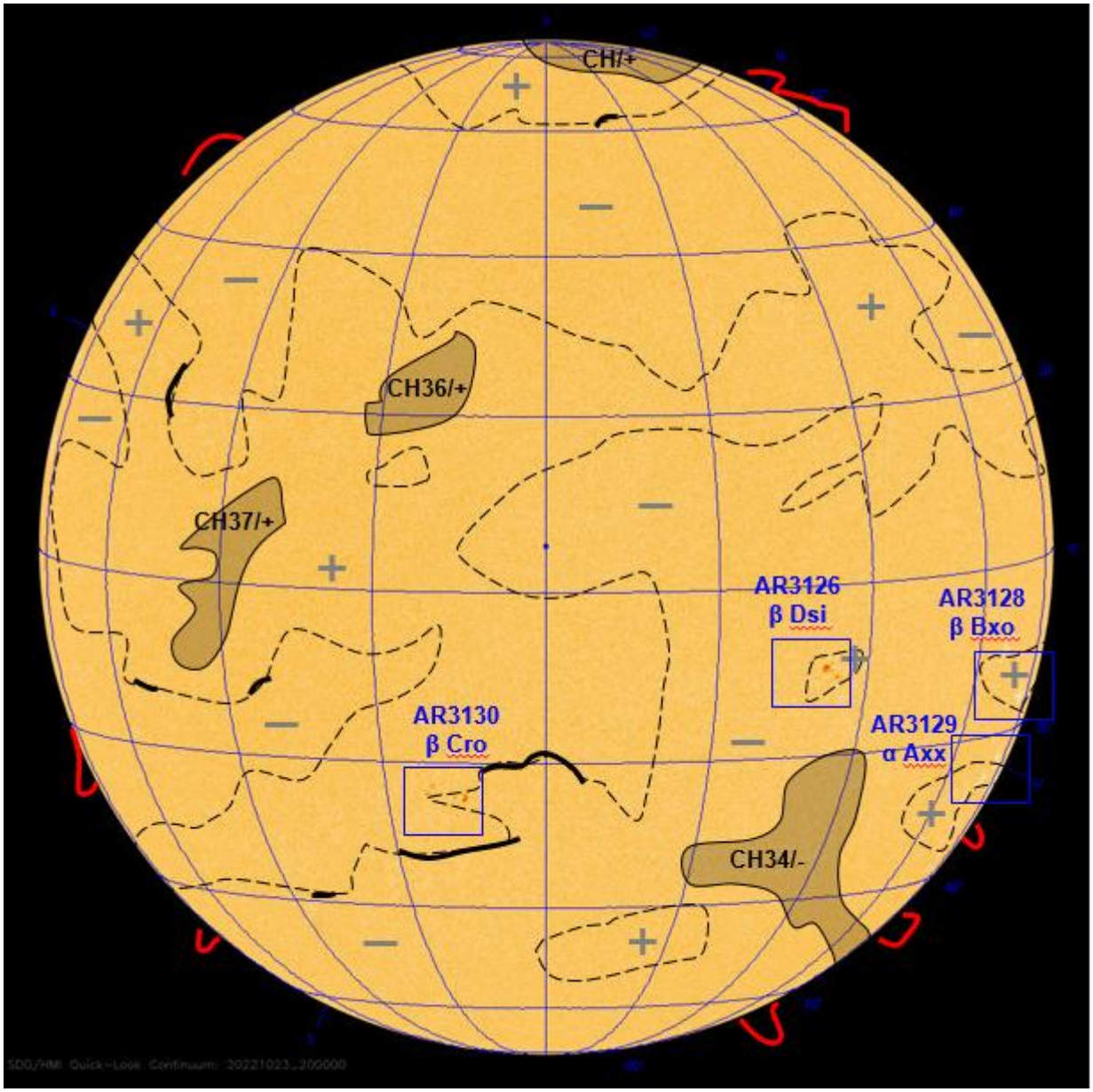
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at background. High energy electron flux (greater than 2MeV) is expected to be mainly background to moderate levels, increasingly reaching high (1e3pfu) levels by the end of the period. Electron fluence values are forecast to remain below the Active threshold on 24 and 25 October, but are likely to exceed the threshold on 26 and 27 October.

Figure 1. Solar Analysis Valid 23/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
No Earth-directed CMEs are currently forecast, but one which left the northwest late on 22 October is currently being modelled. A further CME which left the southwest quadrant during 23 October will be analysed once further imagery becomes available.

The Earth is currently under the influence of a high speed stream from coronal hole 34.and is producing steady speeds of between 500-600km/s. Observations of the solar wind from STEREO A, which is just over one day ahead in Earth's orbit are suggesting a possible increase to 650-700km/s on 25 October, but given a recent slight dip in values, this is considered low confidence. A gradual return to ambient values are then possible during 26 and 27 October.

Geomagnetic activity is forecast to be mainly Unsettled to Active, with a chance of G1/Minor Storms through 24 October due to elevated solar wind speeds and a moderate interplanetary magnetic field strength. A further chance of G1/Minor Storms on 25 October, but with declining activity to mainly Quiet to Unsettled, as speeds are expected to decline. Generally Quiet to Unsettled values are then forecast for 26 and 27 October.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	10	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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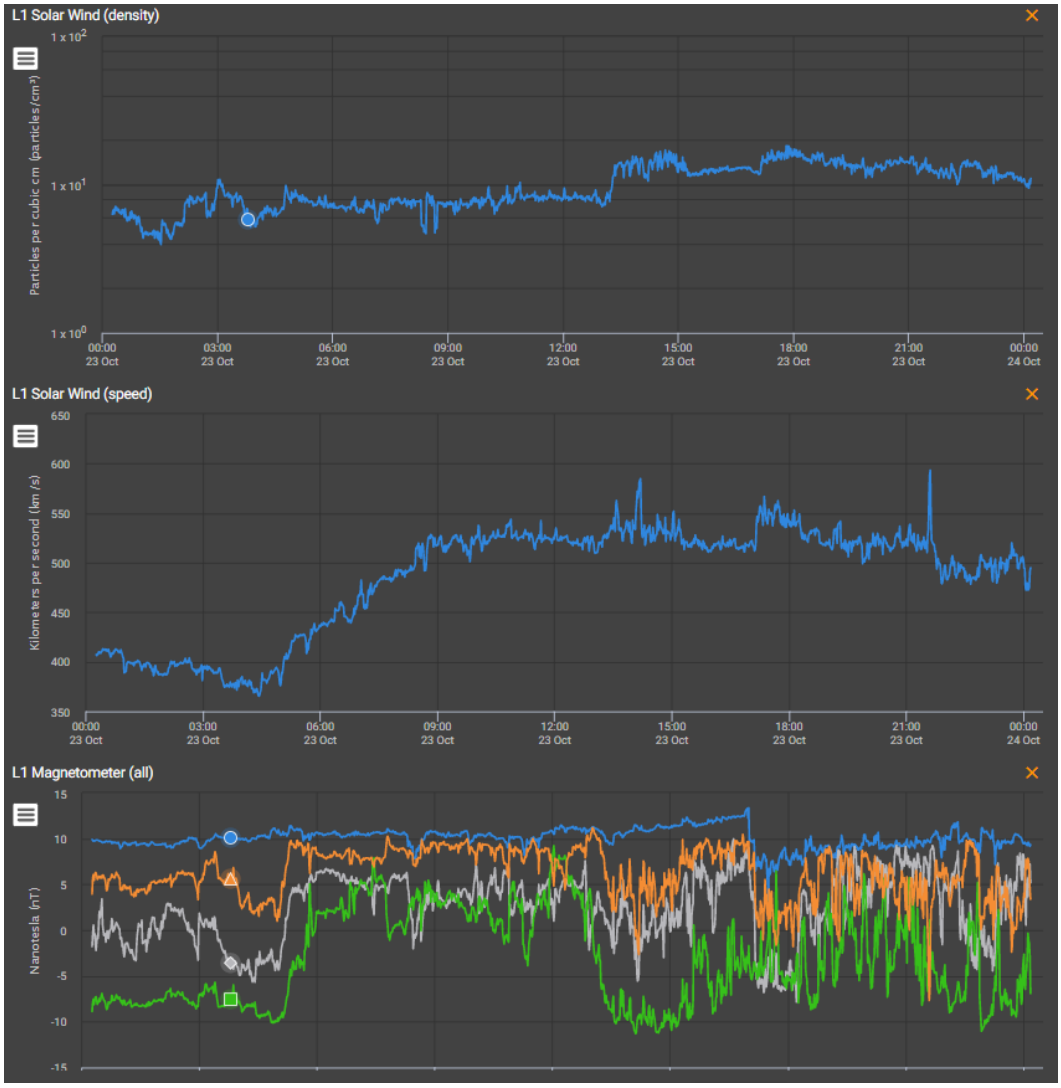
Figure 2: Observations of solar wind parameters at L1



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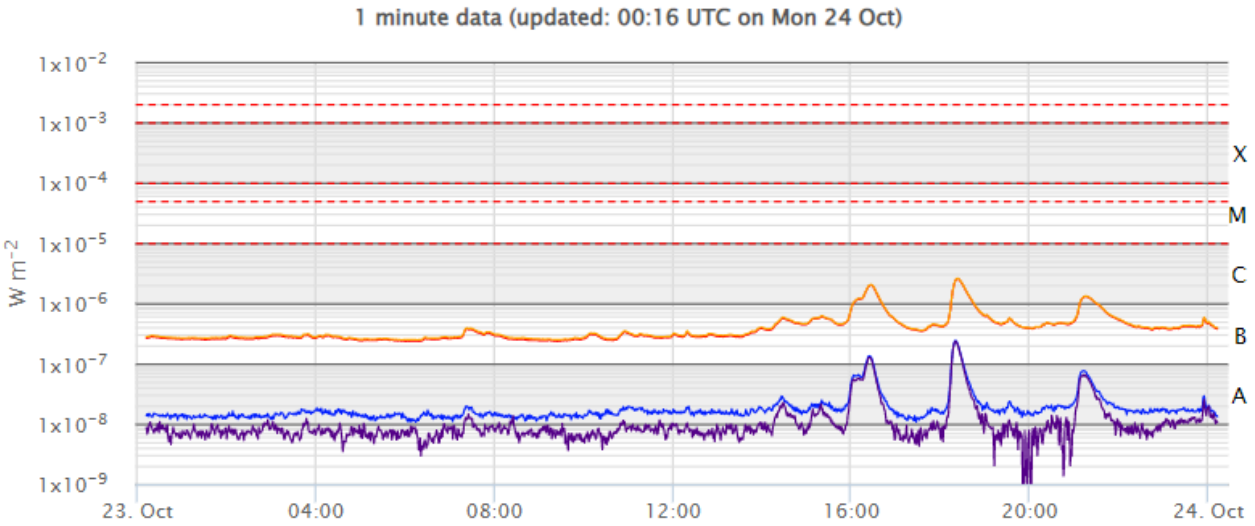
Radio Blackouts - X-Ray Flares:
Solar activity is Low, with four sunspots on the visible disc. The majority of the activity has been from evolving region AR3129 (Cro/Beta) in the southeast quadrant. The other significant region on the visible disc AR3126 (Dsi/Beta) in the southwest quadrant which is also evolving. There is a slight but increasing risk from flare activity from both these regions, with two further sunspots weakening and also expected to rotate off the visible disc.

A number of regions are close to eastern limb and are expected to rotate onto the visible disc later in the period, with a corresponding increase in M-class flare activity forecast. Solar activity is expected to be mainly Low or Very Low, but with a slight chance of Moderate activity later in the period.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	5	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES16 is currently at background and expected to stay at this level with no significant active regions on the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) fell sharply from high to background levels over the last 48 hours, likely due to the compression of the radiation belts out of their natural orbits in the presence of an elevated high speed stream. This high speed stream is expected to input further particles into the belts, which should then relax into their natural orbits from later on 25 through to 27 October as the high speed stream from coronal hole 34 wanes. Electron flux is expected to increasingly reach High (1e3pfu) levels by the end of the period.

Electron fluence values are expected to remain below the Active (1e8 integrated pfu) on 24 October and for much of 25 October. The fluence is then expected to increase rapidly in line with a sharp increase in the flux from later on 25 October, with a chance of the Active threshold being reached.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	20	40	50
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	2	5	5

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